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Analysis of conservation agriculture preferences for researchers, extension agents, and tribal farmers in Nepal using Analytic Hierarchy Process

Brinton Reed [a,*], Catherine Chan-Halbrendt [a,1], B.B. Tamang [b,2], Narendra Chaudhary [c,3]

[a] Dept. of Natural Resources and Environmental Management, University of Hawaii at Manoa, 1910 East-West Road, Sherman 101, Honolulu, HI 96822, USA
[b] Local Initiatives for Biodiversity, Research and Development, P.O. Box 324, Pokhara Gairapatan, Kaski, Nepal
[c] Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal

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ABSTRACT

Many smallholders in Nepal rely on marginal lands that are subject to declining fertility due in part to traditional farming practices. The adoption of conservation agriculture practices has the potential to improve livelihoods and food security but depends on knowledge sharing among farmers, extension agents, and researchers. This study uses Analytic Hierarchy Process (AHP) to determine farmer, extension professional, and researcher preferences for selected conservation agriculture production systems (CAPS) and a widely-practiced traditional production system. This data is then used to determine which CAPS have the highest likelihood of adoption and identify misunderstandings or knowledge gaps among farmers, extension personnel and scientists. AHP was conducted in three tribal villages and at two NGOs that provide research and extension services to smallholders in the central Middle Hills region of Nepal. Overall, soil quality was identified as the most important factor affecting long-term household income, the primary motivator of adoption in study villages. Farmers generally preferred full tillage followed by cowpea solo crop in the second growing season while extension agents and researchers preferred strip tillage followed by cowpea and millet intercrop in the second season. Results indicate that (1) stakeholders prefer CAPS over traditional systems, (2) farmers prefer full tillage over minimum tillage and (3) the farmers in the village of Khola Gaun may be more prepared to adopt minimum tillage and intercropping than the other villages. Communication among all stakeholders should be improved and the results of on-farm plots should be used to reinforce understanding of CAPS benefits. It should be kept in mind that labor savings is not a main motivator of adoption among village farmers and further research should be conducted in Khola Gaun to learn why farmer preferences there differ significantly from farmer preferences in other villages.

1. Introduction

Nepal is a mostly agrarian nation – 80% of its population depends on agriculture for their livelihoods and agricultural production contributes approximately a third to its GDP (Sharma and Khanal, 2010). Nepal is also underdeveloped and very poor; the Human Development Index ranks it 157 out of 187 countries and nearly 25% of its citizens lived on less than $1.25 USD a day in 2010, making it among the poorest countries in the world (UNDP, 2012; World Bank, 2012a, 2012b). Malnutrition is a serious problem (Rajbandari et al., 2011); about 50% of children under five years old are physically stunted and about 36% are underweight (World Bank, 2012a). Over 90% of Nepal's population lives in rural areas where food security is especially low and likely to decrease in the near future, putting Nepal at high risk of food crises (FAO, 2012a; Shively et al., 2011).

Widespread deforestation and the use of intensive agriculture practices on already marginal land has led to elevated soil erosion and soil nutrient depletion (Neupane et al., 2002) which in turn have resulted in agricultural productivity that lags behind that of its regional and economic peers (Fig. 1; World Bank, 2012b). Nepal's central "Middle Hills" region (also called Mid Hills or

* Corresponding author. Tel.: +1 (808) 754 8460.
E-mail addresses: beefreed@yahoo.com (B. Reed), chanhalb@hawaii.edu (C. Chan-Halbrendt), Info@libird.org (B.B. Tamang), admin@iaas.edu.np (N. Chaudhary).
[1] Tel.: +1 (808) 956 7530.
[2] Tel.: +977 61 535357/526834.
[3] Tel.: +977 56 591141.

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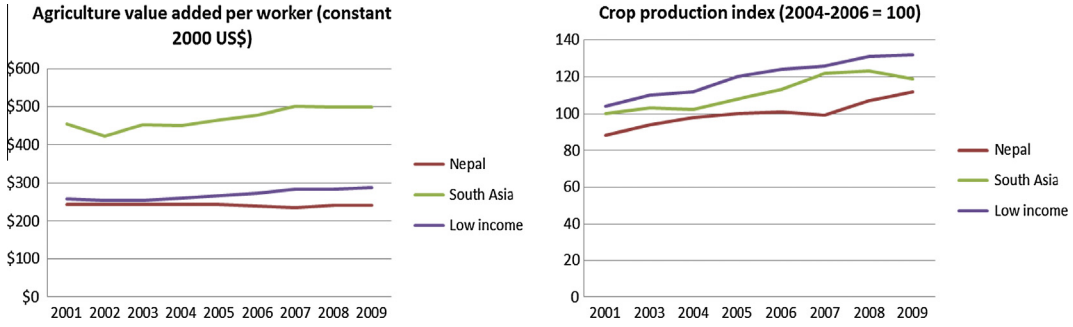

Fig. 1. Agricultural productivity for Nepal, South Asia countries (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka), and low income countries (2011 GNI per capita of USD $1025 or less) as measured by agriculture value added per worker and crop production index.

Middle Mountains in scientific literature) has a high food deficit – an estimated 281,000 MT in 2007 – and farming households in the Middle Hills have been identified by FAO (2007) as being among the most vulnerable groups in Nepal. Food production in these areas is characterized by smallholder subsistence farming on *bari*, or terraced rain-fed plots. These plots typically have low production capacity and highly erodible soils, making the Middle Hills increasingly susceptible to seasonal food insecurity (Sharma and Khanal, 2010; Tiwari et al., 2008). Erosion and nutrient depletion have been identified as major causes of marginal productivity on such plots (Eswaran et al., 2001) and pose serious threats to the survival and livelihoods of farmers there (Pilbeam et al., 1999; Shrestha et al., 2004).

There is growing concern about accelerating soil degradation in the Middle Hills and mountain regions resulting from expansion of agriculture land use, traditional agricultural production systems, and the intensification of farming (Acharya and Kafle, 2009; Brown and Shrestha, 2000; Dougill et al., 2001; Matthews and Pilbeam, 2005; Paudel and Thapa, 2004). The adoption of production systems incorporating conservation agriculture (CA) practices in the Middle Hills could enable rural farmers on marginal land to achieve sustained production and improve their livelihoods (Hobbs et al., 2008; Hobbs, 2007; Kassam et al., 2009). Despite this, CA adoption in Nepal's Middle Hills remains quite low (Derpsch and Friedrich, 2009; Tiwari et al., 2008). Kassam et al. (2009) suggest that despite its agricultural and environmental benefits, CA represents a "fundamental change in production system thinking," and has "counterintuitive" and "often unrecognized elements" that, without an understanding of ecological processes, is very difficult to implement correctly over the long-term. Low adoption rates in the Middle Hills may be attributed to the knowledge-heavy nature of CA combined with significant adoption risk for resource-poor farmers (Friedrich and Kassam, 2009). In addition, previous research has suggested that scientists and subsistence farmers often have difficulty appreciating each other's knowledge, expertise, and preferences which can negatively affect adoption of new technologies (Carr and Wilkinson, 2005; FAO, 2008; Kassam et al., 2009; Probst et al., 2007). Nevertheless, efforts to increase communications with rural farmers and to better understand their preferences could have a positive effect on adoption. Indeed, Paudel and Thapa (2004) found that that close contact with extension services was the greatest factor encouraging adoption of new land conservation technologies among farmers in the Middle Hills. It is thus incumbent upon extension organizations and researchers to understand the conditions and mindset of farmers in order to transfer CA in a way that fits within the context of host cultures and traditional farming practices. Learning farmer preferences for conservation practices and methods of adoption is an important first step in this process. This study identifies preferences for the introduction of legume intercropping, crop rotation(with and without legumes) and reduced tillage practices among several Middle Hills farming communitiesas well as the extension and research organizations they work with in order to facilitate adoption of CAPS and ultimately contribute to improved livelihoods in the region.

2. Background

This research is part of a worldwide effort to combine individual CA concepts and integrate them into the production cycle of traditional farming systems. These conservation agriculture production systems (CAPS) are sets of CA practices adapted to the local environments of smallholders in developing countries for the purpose of increasing adoption rates and improving long-term soil quality and fertility. Generally, CAPS consist of three principal elements: year-round soil cover, minimized soil disturbance, and crop rotation (SANREM CRSP, 2012). CAPS take a holistic, systems approach to CA technologies that, if implemented correctly, are more powerful than such technologies practiced individually. By combining multiple localized strategies in each growing season, the use of CAPS can have synergistic effects on soil structure, moisture, and nutrition, resulting in increased yields and, if markets are available, income for farmers. For the reason that CAPS are developed to take advantage of local growing conditions and complement current farmer practices, they may show high rates of adoption in areas where individual CA components are not yet practiced.

This study takes place in the Middle Hills of Nepal in and around the Trisuli River valley. This area was chosen due to accessibility and the prevalence of rural smallholder farming on marginal, *bari* plots. In addition, food security is a concern in the area and adoption of CAPS is expected to improve the livelihoods of local tribes there. Table 1 presents a socio-economic snapshot of each of the three villages of this study.

The primary objective of this research is to improve the likelihood of CA adoption by tribal villages through the identification and communication of differences in preference for CAPS by in-country extension and research organizations and the farmers with which they work. The specific objectives of this study are:

1. Conduct Analytic Hierarchy Process (AHP) to determine farmer, extension agent, and researcher preferences for selected conservation agriculture production systems (CAPS).
2. Conduct a comparative analysis of farmer, extension agent, and researcher preferences in order to identify knowledge gaps or differences in perception.
3. Make recommendations to in-country partner organizations and other decision-makers in order to facilitate efficient technology transfer.

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